falling and despairing, a helper and encourager of the useful and active; and she may be all this and more in a manner which no man, however able or gifted, can fully or effectually imitate. But to secure such fruits as these, she must have sown abundantly the good seed of mental and moral discipline in the sunny spring time of youth. Lastly, with reference to this branch of the subject, it may be maintained that liberal culture will fit a woman better even for the ordinary toils and responsibilities of household life. Even a domestic servant is of more value to her employer if sufficiently intelligent to understand the use and meaning of her work, to observe and reason about the best mode of arranging and managing it, to be thoughtful and careful with reference to the things committed to her charge. How much more does this apply to the head of the house, who, in the daily provisioning and clothing of her little household army, the care of their health, comfort, occupations and amusements, the due and orderly subordination of the duties and interests of servants, children, and friends, and the arrangement of the thousand difficulties and interferences that occur in these relations, has surely much need of system, tact, information, and clearness of thought. We realise the demands of her position only when we consider that she has to deal with all interests from the commonest to the highest, with all classes of minds from the youngest and most untutored to the most cultivated; and that she may be required at a moment's notice to divert her thoughts from the gravest and most serious concerns to the most trifling details, or to emerge from the practical performance of the most commonplace duties into the atmosphere of refined and cultivated society. But it would be altogether unfair to omit the consideration of still another aspect of this matter. Woman has surely the right to be happy as well as useful, and should have fully opened to her that exalted pleasure which arises from the development of the mind, from the exploration of new regions of thought, and from an enlarged acquaintance with the works and ways of God. The man who has enjoyed the gratification of exercising his mental powers in the fields of scientific investigation or literary study—of gathering their flowers and gems, and of breathing their pure and bracing atmosphere, would surely not close the avenues to such high enjoyment against woman. The desire to do so would be an evidence of sheer pedantry or moral obliquity, of which any man should be ashamed. On the contrary, every educated man and woman should in this respect be an educational missionary, most desirous that others should enjoy these pleasures and privileges, both as a means of happiness and as a most effectual preventive of low and pernicious tastes and pursuits.

RECENT RESEARCHES ON FLIGHT[*]

OF late the perplexing problem of flight has received a greater amount of attention from physiologists and savants than has been bestowed upon it for years, and the result of their researches and experiences is in a fair way of becoming remarkable for its fruit-bearing character. Whilst abroad, such men as Borelli, Straus-Durckheim, Chabrier, Girard, and Marey, have severally given to the world the gist of their labours in this branch of science; at home, the Duke of Argyll and Dr. J. Bell Pettigrew have awakened our deep interest by their views on natural and artificial flight. To the latter is due the honour of giving birth to the celebrated "figure-of-8 wave theory," that is now attracting so much notice in our aeronautical schools.

As early as 1867, Dr. Pettigrew delivered, before the Royal Institution of Great Britain, a lecture, in which he propounded that novel theory, and in 1868 he published in the "Transactions" of the Linnean Society an elaborate memoir on "The Mechanical Appliances by which Flight is attained in the Animal Kingdom." The year after, Prof. J. E. Marey, in the "Revue des Cours Scientifiques," bore out Dr. Pettigrew's ideas, by the detail of his experiments with the sphygmograph, with which he succeeded in causing the wings of insects and birds to register their own movements. He says:—"But if the frequency of the movements of the wing vary, the form does not vary. It is invariably the same; it is always a double loop, a figure of 8. Whether this figure be more or less apparent, whether its branches be more or less equal, matters little: it exists, and an attentive examination will not fail to reveal it." An indefatigable worker, Dr. Pettigrew continued, without pausing, the task to which he had set himself—and that to him is indeed a labour of love; and in this year's "Transactions" of the Royal Society of Edinburgh, we have from his pen a complete monograph on "The Physiology of Wings," in which he treats with equal felicity of both natural and artificial flight. The mass of interesting fact brought to light by the author is too copious to allow of lengthened discussion, but from it we abstract the following items:—

"The wing is generally triangular in form. It is finely graduated, and tapers from the root towards the tip. It is likewise slightly twisted upon itself, and this remark holds true also of the primary or rowing feathers of the wing of the bird. The wing is convex above and concave below; this shape, and the fact that in flight the wing is carried obliquely forward like a kite, enabling it to penetrate the air with its dorsal surface during the up stroke, and to seize it with its ventral one alike during the down and up strokes. The wing is moveable in all its parts; it is also elastic. Its power of changing form enables it to be wielded intelligently, even to its extremity; its elasticity prevents shock, and contributes to its continued play. The wing of the insect is usually in one piece, that of the bat and bird always in several. The curtain of the wing is continuous in the bat, because of a delicate elastic membrane which extends between the fingers of the hand and along the arm; that of the bird is non-continuous, owing to the presence of feathers, which open and close like so many valves during the up and down strokes.

"The posterior margin of the wing of the insect, bat, and bird, is rotated downwards and forwards during extension, and upwards and backwards during flexion. The wing during its vibration descends further below the body than it rises above it. This is necessary for elevating purposes. The distal portion of the wing is twisted in a downward and forward direction at the end of the down stroke, whereas at the end of the up stroke it is twisted downwards and backwards. The wing during its vibrations twists and untwists, so that it acts as a reversing reciprocating screw. The wing is consequently a screw, structurally and functionally. The blur or impression produced on the eye by the rapidly oscillating wing is twisted upon itself, and resembles the blade of an ordinary screw-propeller. The twisted configuration of the wing and its screwing action are due to the presence of figure-of-8 looped curves on its anterior and posterior margins; the curves, when the wing is vibrating, reversing and reciprocating in such a manner as to make the wing change form in all its parts."

We may further point out that Dr. Pettigrew has not based his ideas on the structure of wings on mere theoretical considerations. Besides elaborate anatomical examination, he has entered with a true experimental spirit into a close study of the visible movements of most of the winged tribe. The very excellent diagramatic views with which his paper is elaborately illustrated convey at a glance much that it is difficult to express in words. In proof of this the reader need but compare those figures bearing on the wing movements of the butterfly, the dragon-fly, and the bird.

On these and similar deductions from the practical study of natural history, Dr. Pettigrew bases his elements of artificial flight.

J. MURIE

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[*] Communicated by the Author from *Land and Water*.

INSTRUCTIONS FOR OBSERVERS, AT THE ENGLISH GOVERNMENT ECLIPSE EXPEDITION, 1871

SPECTROSCOPIC OBSERVATIONS

THE instruments used should, if possible, be of the following forms; and experience has shown that they should all be equatorially mounted and driven by clockwork (E of course excepted):—

Instrument A.—An analysing spectroscope showing the whole spectrum in one field, with reference spectra, or some means of rapid record, and with long slit and long collimator mounted at right angles to the axis of a reflecting telescope of large aperture and short focal length, with large finder, the slit of the spectroscope, of course, lying in the focus of the speculum. This combination enables us to obtain a small bright image of the corona, and by throwing this small image on the long slit, to observe the spectrum of the corona on both sides the dark moon—the long collimator permitting the slit to be as wide as possible, so that the maximum of light is admitted. The prism throwing the reference-spectrum into the collimator slides along a bar, so that the reference-spectrum may be made to occupy any part of the field, the height of this spectrum forming a standard of measurement.

Instrument B.—An integrating spectroscope, mounted equatorially, with clockwork or some equivalent arrangement, with long collimator, and object-glass of such aperture that an angle of about 3° is taken in. This, by means of a finder, should be directed to the sun's centre. It should be furnished with a reference-spectrum, or ready means of record.

Instrument C.—An analysing spectroscope of great dispersive power and automatic arrangement, attached to a clockwork-driven equatorial reflector or refractor, in the manner used for observations on the Janssen-Lockyer method.

Instrument D.—An analysing spectroscope of moderate or small dispersive power, attached to an equatorial in the same manner.

Instrument E.—A hand integrating spectroscope.

Instructions for Use of Instrument A.—With this instrument it should be sought to determine, if possible :—

1. The spectrum of corona visible before and after totality.
2. The spectrum of any bright rays visible before or after totality.
3. The spectrum of lowest layer of chromosphere *just* preceding and following totality.
4. Whether there are any dark lines (attention to be directed to D, E, *b*, F only) in the spectrum of the corona during totality, at any distance from the sun; and, if so, at what distance?
5. The spectrum of any bright streamer seen during totality.
6. The existence and position of bright lines between D and 1474 (Kirchhoff) during totality.
7. Comparative heights of C, D^3, F, and 1474 (Kirchhoff), and lines, if any, between D and 1474 during totality.
8. The spectrum of the dark moon.

The observations should be conducted as follows :—

1. If reference-spectra are used, connect the bar carrying the spark-tube, by means of a piece of string, to the eye-piece, so that the amount of light thrown by the small lens on to the slit, and parallel to it, may be controlled.
2. Carefully adjust the finder.
3. Have a slit of such width that on a very faint cloud, with the whole aperture of the reflector, the principal lines of the solar spectrum are alone visible (the three lines of *b* should appear as two).
4. Rotate the telescope-tube in order that the slit may lie along the line joining the points of contact at beginning and end of totality.
5. The observer at the finder should bring the streamer on to the slit, without rotating the telescope-tube.
6. If there are clouds near the sun, on no account move the telescope in right ascension, or meddle with the clock.

Instructions for Use of Instruments B and E.—With these instruments it is possible to examine the changes which take place in the quality of the total amount of light proceeding from the circumsolar regions during the whole time of greatest obscuration. The observations may be made, say, from half an hour before totality to half an hour after; during totality, and if rapid changes are discovered before or after, the observations should be recorded every ten seconds or so, the times of commencement and end of totality being carefully noted, as it is important to connect the changes observed with the amount of chromosphere visible.

The observations should be conducted as follows :—

1. Adjust the driving-clock carefully to solar motion.
2. Adjust the slit so that most of the principal lines can be seen in the spectrum of a faint cloud.
3. Point the instrument to sun's centre three-quarters of an hour before totality, and connect the clock.
4. As totality approaches, observe which dark lines fade out and then brighten, noting the relative intensity of such bright lines.
5. *At the instant of totality* pay particular attention to the spectrum, in order to ascertain whether all lines are reversed, or only some.
6. During totality note] every ten seconds all changes, especially of intensities, *e.g.*

1474 (Kirchhoff) as compared with . . . . . . F
” ” ” C
” ” ” . . . . . D^3
” ” ” . . . . . *b*
” ” ” any lines between D & 1474
C as compared with . . . . F

7. Note whether C entirely disappears.

Repeat the foregoing observations in reverse order till all changes cease.

Instructions for Use of Instruments C and D.—It is important not only to compare observations made with instruments of large dispersion and those of smaller dispersive power, but to determine the obliterating effect of the atmospheric illumination, so as to render observations made during eclipses comparable with those made on the Janssen-Lockyer method.

The observations with these instruments should be conducted as follows :—

1. Before the eclipse commences sweep round the sun, and giving angles from the true north through the true east of the sun from 0° to 360°,* make a diagram of the chromosphere, its height being determined by the height of the C line; especially note all prominences of both kinds (that is, the diffused and eruptive ones), and the amount of motion indicated by changes in wave-length.
2. Find, near the point at which the sun will disappear, an average plane-topped region of the chromosphere where a little motion on either side does not brighten, or thicken, or lengthen the lines.
3. Observe the spectrum of this, and of the gradually narrowing underlying region of photosphere, and note the effect of the diminution of the photospheric light; such effect may probably be apparent before totality; note increased number of lines, their relative heights, and whether there is a diffused band over *b*; note also the width of F. Note also lines between D and 1474, and which lines disappear as the moon covers the lowest layers of the chromosphere. The spectrum should be swept from C to G before totality, and from G to C immediately totality has commenced.
4. During totality determine how far from the dark moon any spectrum is visible, and what that spectrum is. The brightest part of the *Outer* Corona should be chosen for this observation, the telescope being directed to it by means of the finder.
5. Observe the spectrum of a streamer, also, if there be time.
6. Just before the end of totality watch the chromosphere above the point at which the sun will reappear. Observe the phenomena in reverse order. See III.

Photographic Observations.—The instrument recommended to be employed during the eclipse of this year is a camera of about 4in. aperture and 30in. focal length, equatorially mounted, and driven by clockwork.

The pictures taken with such instruments should be exposed as follows, and negatives only should be taken :—

Where the totality is about 2 minutes.

Beginning.			Middle.			End.
5^s	7^s	10^s	15^s	10^s	7^s	5^s

Where the totality is about 4 minutes.

Beginning.				Middle.				End.
5^s	7^s	10^s	20^s	15^s	20^s	10^s	7^s	5^s

To insure a given number of pictures, it is desirable to have the same number of baths and plate-holders.

If this system be carried out we shall be able—

1. To use equal exposures for the examination of the Corona on either side the middle point of totality *in each series*.
2. To compare pictures of equal exposure taken at the same time with reference to the middle of the phenomenon *at all stations*.
3. To determine the effect of exposure.

Telescopic and Naked-Eye Observations.†—*Before totality.*

1. Note how long the corona is visible before totality along the edge of the dark moon opposite the point at which the sun is about to disappear.
2. Sketch any rays visible before totality; give length, colour, and structure, as well as position.

At commencement of totality.

3. Sketch general outline and any rays (streamers) or rifts.
4. Note if there be a blaze of light or glare where the sun has just disappeared.

Middle of totality.

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* Diagrams should be prepared showing the N. and E. points of sun as seen (1) with the naked eye, (2) in an inverting telescope, and (3) *on the slit plate of the spectroscope*.

† These observations should be made by observers *in pairs*, and they should not compare notes. If telescopes are thus used, 2 inches aperture and a power of 20 should be employed.

5. Sketch general outline, rays (steamers), and rifts.

Near end of totality.

6. Sketch general outline and any rays of streamers or rifts.

7. Note if there be a blaze of light or glare where the sun is about to reappear.

After totality.

8. Sketch any rays that may be visible; give length, colour, and structure, as well as position.

Questions to be answered in writing immediately totality is over.

a. Has there been any change? if so, specify what change.

b. Have especially the *dark rays* or rifts changed?

c. Describe what has been constant throughout, and define its structure.

d. State the colours you observed outside the red prominences.

e. Were the colours anywhere arranged *in layers* round the sun?

f. Were the colours anywhere arranged *radially?*

g. As the moon passed over the sun were the colours similar to those successively thrown over any one portion of the landscape?

h. State colours of rays and of spaces between them.

i. Did the dark rifts extend down to the moon, or did they stop short above the denser layers of the chromosphere?

k. Were the rays brightest near or far away from the moon?

l. What was the comparative brightness of the rays, chromosphere, and outer corona?

N.B.—Cards should be prepared, 8 inches square, with a circle 2 inches in diameter, filled in with some dark colour, in the centre. Round this circle the sketches should be made, the north point (or the vertex, as the case may be) being shown, and whether the sketches were made by means of an inverting telescope or with the naked eye.

SUGGESTIONS FOR TIMING THE PROGRESS OF THE ECLIPSE.—In Sicily, last year, the following method of recording the lapse of time during totality was found to prevent all excitement, and made the 80 seconds seem a very long time.

Determine the number of seconds of totality at the station—say 120.

Then, at the moment of totality, let one person attached to each party of observers, carefully observing the face of a chronometer or watch, say—

"You have now 120 seconds."

After 5 seconds,

"You have still 115 seconds."

After another 5 seconds,

"There are still 110 seconds remaining;"

and so on.

This may be done in a very steadying manner.

The times at which any of the phenomena occur must be noted by another observer. J. N. L.

HISTOLOGY

The Auditory Organ of Gasteropoda

DR. F. LEYDIG, of Tübingen, gives an interesting account of the Auditory Organ of Gasteropoda in the last part of Max Schultze's *Archiv für Mikroskopische Anatomie.* After a short historical introduction, in which the labours of previous observers are referred to, Prof. Leydig describes the form and divisions of the brain or cerebral ganglia in this class, and shows that these are fundamentally the same in *Limax, Arion, Vitrina, Helix, Clausilia, Carychium, Succinea, Physa, Planorbis, Ancylus.* This supraœsophageal or cerebral ganglion in these animals consists of two superior ganglionic lateral masses united by a commissure. The subœsophageal ganglion consists of an anterior portion, the ganglion pedale, and a posterior, the ganglion viscerale, which again are connected with the supraœsophageal ganglion by commissural bands. The ring thus formed is traversed by the œsophagus, the excretory ducts of the salivary glands, and the aorta. The anterior lobes of the cerebral ganglion give off the nerves of the tentacles and the optic nerves, and four other pairs. The auditory organ is *apparently* connected with the anterior division of the subœsophageal ganglion. It varies but little in size in different species, whatever may be their difference in magnitude. The organ is of spherical form, as seen from above, but flattened when seen in profile, where it is in contact with the ganglion. It is composed of a connective tissue capsule, made up of two layers—an outer looser investment, and an inner firmer tissue; between the two is a plexiform arrangement of muscular fibres and fasciculi. The inner capsule is lined by a layer of epithelium, which is thicker opposite the point of attachment of the nerve than elsewhere, and when perfectly fresh presents a very indistinct division into cells; of these there appear to be two varieties characterised by their nuclei; one form of nucleus being small, and lying near the attached surface of the cells, that is to say, externally; the other large and round, with a fusiform nucleus. Cilia appear to be always present, but are so extremely fine as to be occasionally scarcely visible. It is most distinct in *Ancylus fluviatilis*, and in this animal the trembling movement of the otoliths is most perceptible. He has seen appearances in *Helix hortensis* and *Clausilia similis*, which lead him to think that the large nucleated cells have bristles attached to them, instead of cilia like the smaller cells. The otoliths exhibit some, though insignificant, variations in size, form, and number. The majority approximate to an oval form, as in the *Helicinidæ;* they are more pointed in *Ancylus* and *Planorbis.* Smaller animals, as *Carychium minimum*, have very small otoliths. They are rounder in young than in older specimens of *Helix*, and at a later period they assume a cell-like appearance, the central part being clearer than the periphery, or a space forming in it which resembles a nucleolus; but he has no doubt, from his previous observations on the embryos of *Paludina vivipara*, that they crystallise out from the fluid of the auditory vesicle; being at first punctiform bodies, then become pointed at their extremities, and increasing by the deposition of successive laminæ on their surface. The idea suggested that they gain entrance from without is quite erroneous. His examinations of the real connections of the auditory nerve succeeded best in *Vitrina diaphana*, and these showed that the lateral commissures of the brain connecting the supra- and infra-œsophageal masses consist of the two commissures themselves, of a sympathetic nerve, of the auditory nerve or canal, and a blood vessel, all connected together by loose connective tissue. The auditory nerve, after leaving the capsule, first runs obliquely outwards to follow the curvature of the anterior division of the infra-œsophageal ganglion, then suddenly bends upwards, and thus ultimately reaches, not the infra-, but the supra-œsophageal ganglion with which it is really in connection. Though holding the same relation to the ear that the optic nerve does to the eye, it differs from ordinary nerves in being hollow; hence its name of ear canal. The wall consists, like that of a nerve, of a homogeneous membrane, surrounded by looser connective tissue, and lined by epithelium. The interior is not filled with nerve fibrillæ. Prof. Leydig then notices the relations of this nerve to the passage leading from the ear towards the skin in *Cephalopoda*, in connection with which, however, no external opening has been found, though searched for, by Owsjannikow, Kowalewsky, and Boll.

SCIENTIFIC SERIALS

IN the *Quarterly Journal of Science* for October, three of the articles are continuations of papers which have appeared in previous numbers of the Journal. Mr Mungo Ponton concludes his discussion of "Molecules, Ultimates, Atoms, and Waves." Lieut. S. P. Oliver gives another paper "On Modern British Ordnance and Ammunition," detailing the structure of some recently manufactured ordnance; and from the editor we have "Some further Experiments of Psychic Force." After replying to adverse criticisms on his previous paper, Mr. Crookes details some fresh experiments which he considers to "confirm beyond doubt the conclusions at which he arrived in his former paper, namely the existence of a force associated in some measure not yet explained, with the human organisation, by which force increased weight is capable of being imparted to solid bodies without physical contact." The experiments detailed were all performed in the presence of Mr. D. D. Home, or of a lady in whom this force is stated to be remarkably developed; the accordion is no longer employed, while in the balance experiments the operator's hands, instead of lying on the board attached to the balance, are placed in a vessel of water laid on the board. Mr. W. Mattieu Williams gives a useful abstract of the views advanced in his "Fuel of the Sun," for the benefit of those who have not time to read the larger work. The author of an anonymous paper "On the recent Gun-cotton Explosion" condemns the reaction against the use of gun-cotton, which has set in since the Stowmarket catastrophe, and attributes the explosion to culpable carelessness in the process of washing the free acid out